THE AUSTRALIAN
Entomologist

published by

THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND



Volume 26, Part 3, 10 December 1999

Price: $5.00 per part

Published by: THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND

ISSN 1320 6133

THE AUSTRALIAN ENTOMOLOGIST

The Australian Entomologist (formerly *Australian Entomological Magazine*) is a non-profit journal published in four parts annually by the Entomological Society of Queensland. It is devoted to entomology of the Australian region, including New Zealand, Papua New Guinea and islands of the south-western Pacific. Articles are accepted from amateur and professional entomologists. The journal is produced independently and subscription to the journal is not included with membership of the Society.

The Editorial Panel

Editor:	Dr D.L. Hancock Dept of Primary Industries
Assistant Editors	Dr G.B. Monteith Queensland Museum
	Dr C.J. Burwell Queensland Museum
	Mr G. Daniels University of Queensland
Business Manager	Mr P. Bouchard University of Queensland

Subscriptions

Subscriptions are payable in advance to the Business Manager, The Australian Entomologist, P.O. Box 537, Indooroopilly, Qld, Australia, 4068.

For individuals	A$16.00 per annum Australia
	A$20.00 per annum elsewhere
For institutions	A$20.00 per annum Australia.
	A$22.00 per annum elsewhere.

Cheques in currency other than Australian dollars should include an extra A$5.00.

ENTOMOLOGICAL SOCIETY OF QUEENSLAND

Membership is open to anyone interested in Entomology. Meetings are normally held in the Department of Zoology and Entomology, University of Queensland on the second Monday of March-June and August-December each year. Meetings are announced in the Society's News Bulletin which also contains reports of meetings, entomological notes, notices of other Society events and information on Members' activities.

Enquiries relating to the Society should be directed to the Honorary Secretary, Entomological Society of Queensland, C/- Department of Zoology and Entomology, University of Queensland, Brisbane, Qld, 4072.

Sustaining Associates

Arrest-A-Pest Pty Ltd, Rhone-Poulenc Rural Australia Pty Ltd.

Cover: Ornate false spider mites (Tuckerellidae) are early derivative members of the economically important Tetranychoidea - spider mites, clover mites, flat mites, etc.. This species, *Tuckerella* sp. nr. *flabellifer* Miller, feeds on the stems of the introduced weed lantana and on a variety of native trees and shrubs. Illustration by Juanita Choo, Department of Zoology and Entomology, University of Queensland.

A NEW SPECIES OF *LEUCIACRIA* ROTHSCHILD & JORDAN (LEPIDOPTERA: PIERIDAE) FROM MONTANE NEW IRELAND, PAPUA NEW GUINEA

C.J. MÜLLER

Centre for Ore Deposit Research, University of Tasmania, GPO Box 252-79, Hobart, Tas 7001
Address for correspondence: PO Box 228, Dural, NSW 2158

Abstract

Leuciacria olivei sp. nov. is described and illustrated from high elevations in southern New Ireland, Bismarck Archipelago, Papua New Guinea. The new species is compared with *L. acuta* Rothschild & Jordan, 1905, within the previously monotypic genus.

Introduction

The genus *Leuciacria* Rothschild & Jordan (1905) was proposed for the type species, the previously unique *L. acuta* Rothschild & Jordan. Klots (1933), in his extensive paper dealing with the family Pieridae in general, considered *Leuciacria* to be closest to *Elodina* C. & R. Felder, although he stated that the genus was somewhat isolated in terms of its affinities. Klots (1933) stated that neither the venation nor the genitalia of *Leuciacria* suggested any definite relationships.

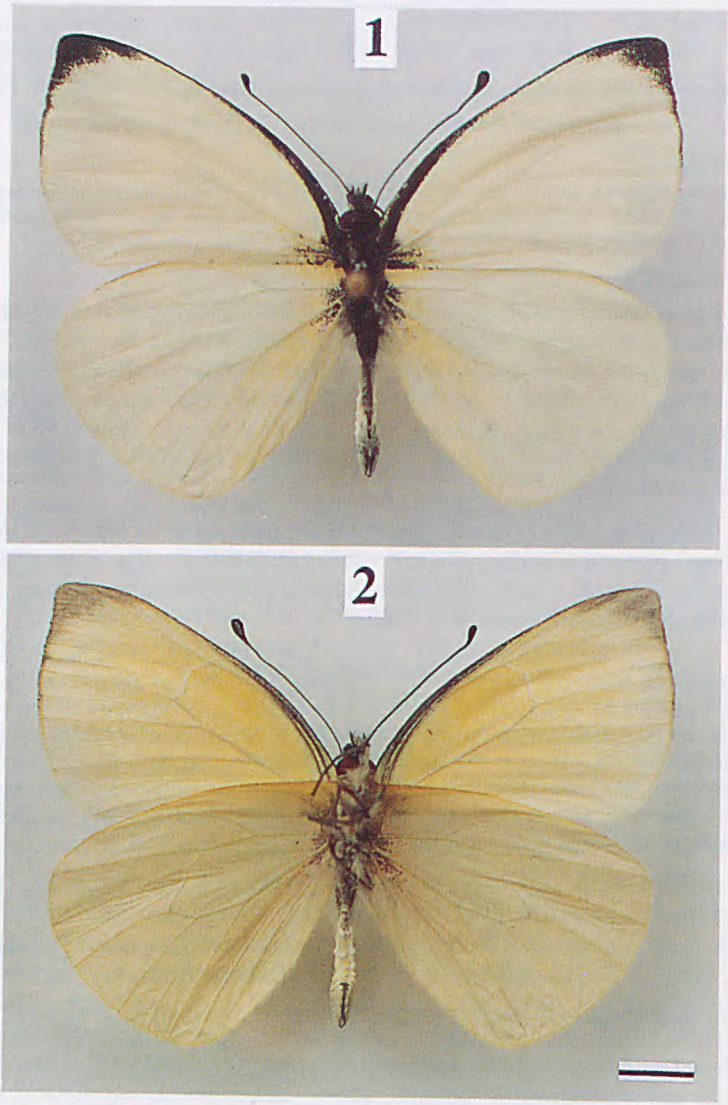
The followings abbreviations are used in this work: ANIC - Australian National Insect Collection, CSIRO, Canberra; BMNH - The Natural History Museum, London; CJMC - Private collection of C. J. Muller, Sydney; JOC - Private collection of John Olive, Cairns

Leuciacria olivei sp. nov.

(Figs 1-3, 5)

Types. Holotype ♂ (ANIC genitalia slide No. 13096), PAPUA NEW GUINEA: "Hans Meyer Ra., 2400 m, S. New Ireland, 22.viii.1998, C.J. Muller" in ANIC. *Paratypes:* 1 ♂, same data as holotype (BMNH); 1 ♂, same data as holotype (JOC); 1 ♂, same data as holotype but dated 20.viii.1998 (CJMC); 1 ♂, same data as holotype, with genitalia dissected and attached to specimen (CJMC).

Description. Male (Figs 1-3). Forewing length 24.8 mm, antenna 12.9 mm. Head black with dense, deep grey hair-tufts, whitish-grey ventrally; antenna black, with conspicous flat club, ventrally white-centered; labial palpus black and hairy. Thorax black above with numerous fine grey hairs, cream beneath; legs grey, tending light brown at end. Abdomen white, with black dorsal ridge tapering posteriorly, claspers grey. Forewing concave between apex and vein M_2, strongly convex between tornus and vein M_2, costa slightly bowed toward base, apex pointed; above cream, costa and apex narrowly black, base with yellow suffusion and with scattering of black scales, cilia cream; beneath cream with costa marginally black, apex light grey-fawn, strong yellow suffusion particularly in distal portion of cell, lessening

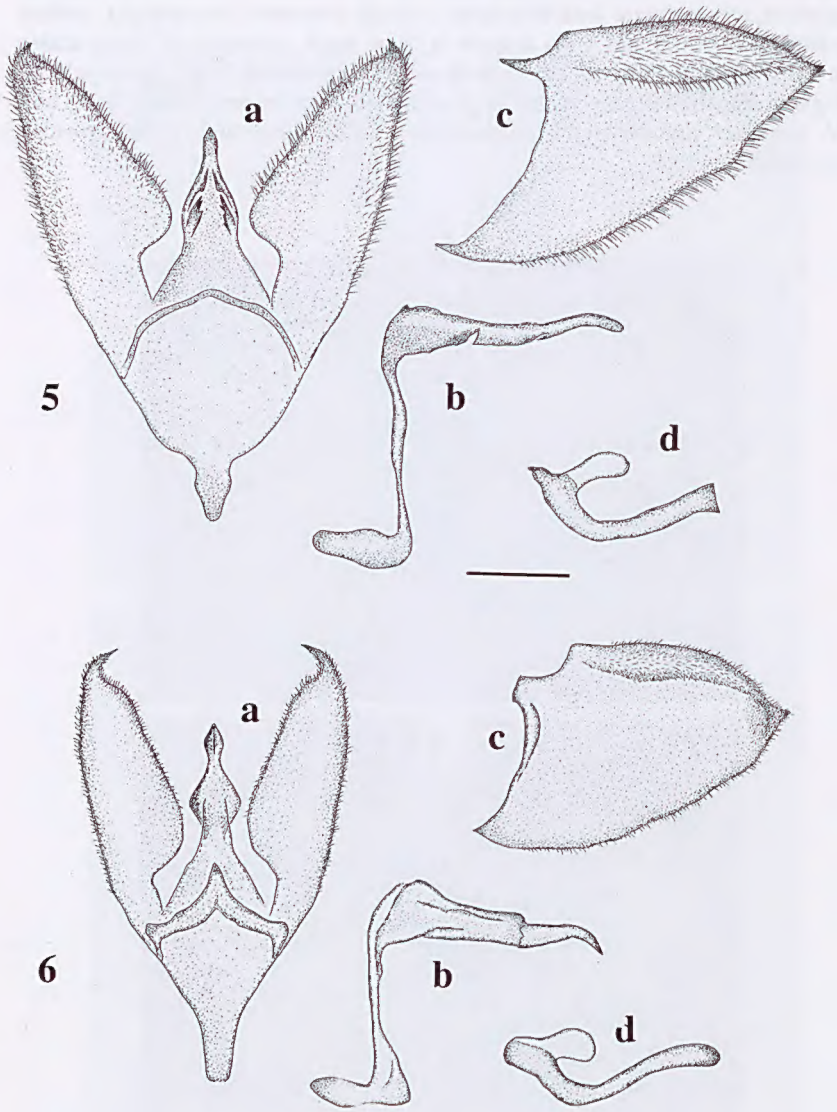


Figs 1-2. *Leuciacria olivei* sp. nov., male. (1) Upperside; (2) underside. Scale bar = 5 mm.

towards termen, cell and veins greenish proximally. Hindwing slightly rounded, above cream with fine hairs in distal area near inner margin, yellow suffusion in costal and inner margin to basal areas, scattering of black scales at base, cilia cream; beneath cream with faint greenish tinge, costa yellow, slight scattering of grey scales in postmedian area between veins CuA_1 and 3A, parallel linearly with termen near tornus, cell and veins greenish proximally.



Figs 3-4. Adult males of *Leuciacria* spp., comparing extent of dense white scales. (3) *L. olivei*; (4) *L. acuta*. Scale bar = 8 mm.



Figs 5-6. Male genitalia of *Leuciacria* spp. **5**. *L. olivei*. (a) dorsal view; (b) vinculum and tegumen ring, lateral view; (c) left valva, lateral view; (d) aedeagus, lateral view. **6**. *L. acuta*. (a) dorsal view; (b) vinculum and tegumen ring, lateral view; (c) left valva, lateral view; (d) aedeagus, lateral view. Scale bar = 0.5 mm.

Genitalia (Fig. 5). Vinculum and tegumen ring broadly oval, indented anteriorly; uncus long, slender, gently dipping, apex dorsally sharply pointed, blunt laterally with median dorsolateral toothed processes; valva long, rather narrow, covered with fine setae, apex with tip hooked, curved inwards, ventrum irregular; tegumen short and bent upwards; aedeagus sharp, irregular basally, squared apically, post-zonal portion bowed strongly.

Female. Unknown

Etymology. Named in honour of Mr John Olive, Trinity Park, Queensland.

Discussion

The discovery of *Leuciacria olivei* sp. nov. in New Ireland is somewhat surprising, as the genus previously has not been recorded outside mainland New Guinea. Parsons (1991, 1998) stated that *L. acuta* flies at 1200-2000 m and is generally a rare taxon. *L. olivei* has been observed and/or collected between 1700 and 2400 m in the Hans Meyer Ra., southern New Ireland. Since intervening New Britain has several mountains that rise above 2000 m, it is suggested that *Leuciacria* may occur there also.

Leuciacria olivei may be separated readily from *L. acuta* (Fig. 4) by the shape of the forewing, which in *L. acuta* is strongly concave between the apex and vein M2. The costa is nearly straight in *L. olivei*, while it is strongly bowed in *L. acuta*, particularly towards the apex. The forewing black apical tip is far more reduced in *L. olivei* than in *L. acuta* and there is a strong yellowish suffusion on the ventral surface of both wings in the former that is not present in *L. acuta*.

In addition, the male genitalia of the two taxa bear several distinguishing features (Figs 5, 6). The uncus in *L. olivei* is slender with toothed dorsal processes, whilst in *L. acuta* it is more simple and diamond-shaped. Laterally, the uncus of *L. acuta* is beak-like in appearance, while that of *L. olivei* is comparatively blunt. The valvae of *L. olivei* are much longer and narrower than in *L. acuta* and the apical hook is much less pronounced than in the latter species. The aedeagus in *L. acuta* is fairly simple and blunt both anteriorly and posteriorly, whereas that of *L. olivei* is sharp and irregular basally, and squared apically.

The habitat for the type series of *L. olivei* is a mixed moss/heath forest which is peculiar to andesitic (ancient volcanic) mountain crests and slopes above 1800 m in southern New Ireland. Adults were taken, together with *Graphium kosii* Müller & Tennent (Papilionidae), *Delias messalina lizzae* Müller (Pieridae), *Parantica fuscela* Parsons and *Cethosia vasalia* Müller (Nymphalidae), as they flew directly and quite rapidly above the canopy which is as low as 6 m in the highest parts of the Hans Meyer Range (Fig. 7).



Fig. 7. Type locality of *L. olivei*, Hans Meyer Range, 2400 m, southern New Ireland.

Acknowledgments

The expedition into remote southern New Ireland was made possible by a number of local people, particularly Joel Todiai, and the author is grateful to them all. Permits to acquire material were issued by the Department of Primary Industries, Namatanai, and the Provincial Government, Kavieng.

References

Klots, A.B. 1933. A generic revision of the Pieridae (Lepidoptera), together with a study of the male genitalia. *Entomologica Americana* **12**(4): 139-242.

Parsons, M.J. 1991. *Butterflies of the Bulolo-Wau valley*. Bishop Museum, Honolulu; 280 pp.

Parsons, M.J. 1998. *The butterflies of Papua New Guinea; their systematics and biology*. Academic Press, London; 736 pp.

Rothschild, W. and Jordan, K. 1905. On some new Lepidoptera discovered by A. S. Meek in British New Guinea. *Novitates Zooligicae* **12**: 448-478.

POSSIBLE POSTCOPULATORY MATE GUARDING IN *ORNITHOPTERA EUPHORION* (GRAY) (LEPIDOPTERA: PAPILIONIDAE)

A.G. ORR

Cooperative Research Centre for Tropical Rainforest Ecology and Management, Environmental Sciences, Griffith University, Nathan, Qld 4111

Abstract

Observations were made on the courtship behaviour of *Ornithoptera euphorion* (Gray) at Bramston Beach, north Queensland. An instance is described of a male, known to have mated with a female, following her for about a day and driving off other males who courted her. Three other examples of apparent guarding involving pairs where mating was not observed are also noted.

Introduction

Following insemination, males of many butterfly species produce a mating plug, which seals the ostium bursae or copulatory opening and prevents or delays remating by the female (Ehrlich and Ehrlich 1978, Dickensen and Rutowski 1989). Owing to the ditrysian arrangement of the female reproductive tracts found in all higher Lepidoptera, the plug does not impede oviposition and may remain in place for life. When freshly formed the plug is soft and gelatinous and over a period of one to two days it contracts and hardens (Orr 1988, Matsumoto and Suzuki 1992). It has been shown in *Atrophaneura alcinous* Klug that the freshly formed plug can be easily penetrated or pushed aside by the aedeagus of another male and that males sometimes cling to mating pairs and mate successfully with the female when the original pair separate (Suzuki and Matsumoto 1990, Matsumoto and Suzuki 1992). This behaviour sometimes also occurs in *Ornithoptera richmondia* (Gray) maintained in captivity (Orr, unpublished observations). It would seem logical therefore, that if males could successfully drive off potential mates in the period following mating while the plug remains soft, they would minimize the risks of the female remating with another male and using his sperm to fertilize her eggs.

The details of courtship behaviour in *Ornithoptera* Boisduval and *Troides* Hübner species have never been fully described and vary considerably with circumstances. However in all species of the two genera for which information is available, including *O. euphorion* (Gray), the male hovers briefly below the female, then flies directly in front of her, possibly brushing her antennae with the androconia which fringe the anal margin of the hindwings, then hovers about half a metre above her. Immediately before a mating or mating attempt, it is common for the male to splay his hindwings slightly and bring them together in an abrupt scissor action, which may serve to disseminate pheromones. Mating is attempted generally only when the female is quiescent, or at least has ceased to flap her wings. This cycle may be repeated many times. It may be performed on newly emerged females,

where mating follows very quickly, or on feeding females and flying females; in the latter case the male describes a series of progressive ellipses about the female as he follows her. Brief accounts of courtship in *T. oblongomaculatus papuensis* Wallace and in *O. richmondia* are given by Parsons (1983) and Orr (1988) respectively. Most of the courtships observed in nature probably involve already mated females and remating seldom results but, as in *O. richmondia* between 10-20% of old females contain more than one spermatophore, polyandry evidently does occur in nature and a small proportion of such courtships must be successful (Orr 1988, unpublished observations).

Methods

Between 8-15 February 1999 I spent a total of 14.5 hours observing the courtship and other sexual interactions of *O. euphorion* around cultivated *Hibiscus* flowers at Bramston Beach, near Innisfail, north Queensland. Owing to legal restrictions on handling this species I was unable to capture and mark individuals, but at least four males and three females were identifiable by the distinctive wing damage. Much wing chipping may have been caused by Yellow-bellied Sunbirds (*Nectarina jugularis*), which frequently pecked the butterflies, apparently in defence of their feeding territories. The butterflies were observed by using compact wide angled binoculars. Any distinguishing marks were noted and recorded. Notes of behaviour were made using a small hand held dictophone.

Results

Five interactions in which a male continually courted a female were followed for approximately half an hour to one hour, until either the pair was lost from sight or the male ceased courtship attempts. Although males often alighted beside or on top of the female and attempted mating, successful coupling was never achieved and, following such attempts, females invariably alighted and flew at least a few metres before resuming feeding, whereupon the male recommenced courtship. On two occasions the male grappled with the female and carried her to the ground but was unable to hold her in either case. In all cases the female was almost certainly mated and probably bore a mating plug, which would have been difficult to dislodge. After such aggressive mating attempts females normally departed. The frequency of mating attempts varied but typically took place every five to fifteen minutes over a period of up to an hour or more.

Such observations are typical of the courtship behaviour of males with mated females which is frequently observed. However on one occasion (12 Feb. 1999) I observed a mated pair arrive at the flowers at 0920h, where they commenced feeding. At 0935h they separated and as both bore distinctive damage I was able to recognize them on subsequent enounters and intermittently observe their behaviour throughout the day. Following

separation the pair remained at the flowers and continued feeding for another 63 minutes. The male remained close to the female and was rarely more than a metre from her. Five minutes after they separated a smaller male arrived at the nectar and, after feeding briefly, began to court the female. The original male tolerated his presence until he had been hovering above the female for about three minutes, when he flew at the intruder and chased him for about 50 metres, then returned to an inflorescence near the female. Over a period of 58 minutes the small male returned and courted the female persistently, only to be attacked and routed by the first male on five occasions. Two cues, which were correlated, seemed to trigger his aggression. He attacked either when the female ceased to flutter her wings while the second male was hovering above her, or when the second male splayed and then snapped his hindwings against his abdomen, a movement which normally indicates an intention to attempt mating. On two occasions the first male grappled with the second and carried him to the ground. At no time did the first male court the female for more than a few seconds and this was only immediately following a serious altercation with the interloper. At 1038h the female flew off, closely followed by the first male. I relocated the same pair later in the day at another clump of *Hibiscus* about a kilometer distant, with the male still in close attendance but not courting the female. On this occasion the pair were observed for 42 minutes, during which time the male drove off two other males, both quite distinct from the original interloper. The pair reappeared at the original location at 1515h. They fed undisturbed for 12 minutes when a small male, almost certainly the original interloper, arrived and after feeding at nectar for five minutes began again to court the female. Between 1520 and 1710h the pair continued to feed with the small male almost continually courting the female. He was driven off on six occasions by the first male. The final interaction, at 1708h, was particularly dramatic. Following a prolonged period of courtship, the interloper dived on the female and carried her to the ground. The first male swooped onto the struggling pair and seized the male, whereupon the female was freed and flew away. After the males had grappled on the ground for about 30 seconds the second male escaped and few away rapidly, with the first in pursuit. I did not see them again that day. Also during this period (i.e. 1520-1710h) two other males arrived and courted the female, sometimes at the same time as the small male, but these were eventually driven off by the original male or lost interest following a series of altercations with the small male.

The following morning at the original site I saw the female again between 0820 and 0930h, this time unaccompanied by the first male, who I observed nectaring at the same site later in the day, between 1310 and 1320h, and again between 1600 and 1630h. On that day, between 1510 and 1640h, I also observed another pair, which although not observed in copula, exhibited similar apparent guarding behaviour to that described above. This male bore no distinguishing marks but he was seen constantly defending the female

from several interlopers, including the male from the previous pair, and particularly the small original interloper described above who he attacked and chased on seven occasions, three times seizing him and taking him to the ground. The female was recognizable and was observed two days later without an escort.

Prior to these observations (8-9 Feb. 1999), I twice observed between 1600 and 1800h a similar series of interactions between a guarding male which fed and did not attempt courtship, a feeding female, and one or more courting males which seldom fed. Other unguarded females also visited the flowers and were subjected to courtship without result, but these usually did not remain at the site for more than half an hour. In the light of the above observations it seems reasonable to suggest that in these cases too the guarding male had mated with the (guarded) female that day, and both were replenishing their energy reserves.

Discussion

While these results do not provide a statistical sample they are sufficiently unique to merit recording. Non-contact mate guarding is widespread in some insects, especially the Odonata (Corbet 1961), but has never been reported in the Lepidoptera. Following mating, females of most species are unresponsive to male courtship for several days, even in polyandrous species (Obara *et al.* 1975, Suzuki *et al.* 1977) and hence a mating plug, if present, is likely to have hardened and be effective by the time the female accepts another mating. Mate guarding would be most expected in species in which forced copulation without courtship occurs. This happens only in sphragis bearing species such as *Cressida cressida* Fabricius and *Acraea andromacha* Fabricius (Orr 1988, 1995, 1999) and a few highly polyandrous species in which males secure many matings and do not produce a mating plug, such as *Danaus plexippus* Linnaeus (occasionally, Pliske 1975) or *Acraea natalica* Boisduval (Orr 1988). In *C. cressida* the female is not normally released until the sphragis is completely hardened (Orr and Rutowski 1992, Orr 1999), a situation analogous to contact mate guarding in the Odonata, and in *A. andromacha* females are usually intercepted at hilltops and at the site of the larval foodplant, rather than at nectar sources which are mostly dispersed; hence freshly mated females are less likely to be molested although this has been recorded (Epstein 1987). Males of polyandrous species which produce no mating plug would be expected to direct their efforts to seeking more mates, rather than attempting to guard one who may be almost guaranteed to remate eventually.

Observations of caged *O. richmondia* suggest that females will accept matings while the plug is still soft, especially if the first male has donated a small spermatophore and the second male is especially persistent. Forced copulation such as occurs in *C. cressida* is probably physically impossible as

the male must force the female to evert her sinus vaginalis, which would be a difficult if not impossible operation if the female did not acquiesce to some extent; but it is possible that a female might accept a mating soon after the first if only to escape the attentions of an especially persistent male. I have not previously witnessed the probable guarding behaviour described above, in either *O. richmondia* or *O. euphorion*, perhaps partly because I have seldom seen such a concentration of *Ornithoptera* in such easy terrain, but it is also possible that the male guarding behaviour occurs only facultatively when population densities are high and females are likely to be subjected to intense courtship from other males immediately after mating.

Acknowledgments

I thank the many residents of Bramston Beach who supported me and my family while floodbound for six days by Cyclone Rona, during which time many of these observations were made.

References

CORBET, P.S. 1961. *The biology of dragonfies.* Witherby, London.

DICKINSON, J.L. and RUTOWSKI, R.L. 1989. The function of the mating plug in the chalcedon checkerspot butterfly. *Animal Behaviour* **38**: 154-162.

EHRLICH, A.H. and EHRLICH, P.H. 1978. Reproductive strategies in the butterflies: I. Mating frequency, plugging and egg number. *Journal of the Kansas Entomological Society* **51**: 666-697.

EPSTEIN, M. 1987. Mating behaviour of *Acraea andromacha andromacha* (Fabricius) in New Caledonia. *Journal of the Lepidopterists' Society* **41**: 119-121.

MATSUMOTO, K. and SUZUKI, N. 1992. Effectiveness of the mating plug in *Atrophaneura alcinous* (Lepidoptera: Papilionidae). *Behavioral Ecology and Sociobiology* **30**: 157-163

OBARA, Y., TATEDA, H. and KURABARA, M. 1975. Mating behaviour of the cabbage butterfly, *Pieris rapae crucivora* Boisduval. V. Copulatory stimuli inducing changes in female response patterns. *Dobut Zasshi* **84**: 71-76.

ORR, A.G. 1988. *Mate conflict and the evolution of the sphragis in butterflies.* Unpublished PhD thesis, Griffith University, Nathan; 348 pp.

ORR, A.G. 1995. The evolution of the sphragis in the Papilionidae and other butterflies. Chapter 16, *in:* Scriber, J.M., Tsubaki, Y. and Lederhouse, R.C. (eds), *Swallowtail butterflies: their ecology and evolutionary biology.* Scientific Publishers, Gainesville; pp 155-164

ORR, A.G. 1999. Biology of *Cressida cressida* (Fabricius) (Papilionidae: Troidini). *In:* Kitching, R.L., Scheermeyer, E., Jones, R.E. and Pierce, N.E. (eds). *Biology of Australian butterflies. Monographs on Australian Lepidoptera* **6**. CSIRO Publications, Melbourne.

ORR, A.G. and RUTOWSKI, R.L. 1991. Mating plug carried by female signals mated status to male in the Big Greasy, *Cressida cressida* (Lepidoptera: Papilionidae). *Journal of Natural History* **25**: 703-710.

PARSONS, M.J. 1983. Notes on the courtship of *Troides oblongomaculatus papuensis* (Papilionidae) in Papua New Guinea. *Journal of the Lepidopterists' Society* **37**: 83-85.

PLISKE, T.E. 1975. Courtship behaviour of the monarch butterfly *Danaus plexippus* L.. *Annals of the Entomological Society of America* **68**: 143-151.

SUZUKI, N. and MATSUMOTO, K. 1990. Pair clinging behaviour of *Atrophaneura alcinous* (Lepidoptera: Papilionidae). *Journal of Ethology* **8**: 45-51.

SUZUKI, Y., NAKANISHI, A., SHIMA, H., YATA, O. and SAIGUSA, T. 1977. Mating behaviour of four Japanese species of the genus *Pieris* (Lepidoptera, Pieridae). *Kontyu* **45**: 300-313.

CORRIGENDA

In Figure 1 of Orr and Kitching (1999), captions (i) and (j) are transposed. Fig. (i) is *Beara falcata*; fig. (j) is *Scaphidriotis* sp.

ORR, A.G. and KITCHING, R.L. 1999. A checklist of macrolepidoptera collected from rainforest and former forest areas on basalt soils on the Atherton Tableland. *Australian Entomologist* **26**(1): 15-27.

USE OF ODONATA AS PREY BY SAND WASPS, *BEMBIX* SPP. (HYMENOPTERA: SPHECIDAE)

A.D. AUSTIN

Department of Applied and Molecular Ecology, Waite Campus, The University of Adelaide, PO Glen Osmond, SA 5064 (email: aaustin@waite.adelaide.edu.au)

Abstract

The sphecid wasp *Bembix minya* Evans & Matthews from southern South Australia is recorded for the first time as preying on damselflies (Odonata). Details of its nest structure and prey range are presented, as is a discussion of the evolutionary transition within the genus to utilising prey other than Diptera.

Introduction

Bembix F. is a large cosmopolitan genus of sphecid wasps comprising about 330 described species, 82 of which occur in Australia (Evans and Matthews 1973, Bohart and Menke 1976). They are often extremely common in sandy habitats such as along beaches and the dunes of arid and semi-arid deserts. With one exception (Evans 1978), species elsewhere in the world exclusively provision their brood chambers with various paralysed adult Diptera (usually muscoids, syrphids, dolichopodids and therevids) as food for a single developing larva (Evans and Matthews 1973, Bohart and Menke 1976). It is this biology and the fact that nest construction and provisioning can be observed easily that has lead to the genus being used in studies of comparative insect behaviour (e.g. Evans 1957, 1966, Evans and Matthews 1973).

Compared with other continents, the Australian *Bembix* fauna is particularly interesting in that several species prey on insect groups other than Diptera, including thynnine wasps, colletid, halictid and *Trigona* Jurine bees, myrmeleontid lacewings and Odonata (Evans and Matthews 1973, Evans *et al.* 1982). Two species have been recorded as provisioning their nests with damselflies, *B. coonundura* Evans & Matthews from Lake Violet in Western Australia, and *B. variabilis* Smith from Darwin and the Ord River near Kununurra (Evans and Matthews 1973). A third species, *B. allunga* Evans & Matthews, is known to utilise adult libellulid dragonflies at Kemp Beach near Yeppoon, Queensland (Evans *et al.* 1982). However, *B. variabilis* and *B. allunga*, both of which are widely distributed across the continent, are not obligate predators of Odonata. More commonly they prey on a wide variety of other insects, which include at least 12 dipteran families in the case of *B. variabilis*, while *B. allunga* preys on various families of Diptera and Neuroptera. In this study a fourth species, *B. minya* Evans & Matthews from southern South Australia, is also recorded as preying on damselflies. Details of its nest structure and prey range are presented, as is a discussion of the evolutionary transition within the genus to utilising prey other than Diptera.

Materials and Methods

Observations were made over a period of two days in mid-March 1993 at Wistow, 4 km south of Mt Barker in the Adelaide Hills, South Australia (Fig. 1). The nests originally were discovered by accident when a two-tonne pile of builder's sand that had been at the site for the previous seven days, was moved using a spade. Five nests were discovered, two of which were partially disturbed by the spade, while the other three were completely destroyed but recognisable by three semi-discrete groups of damselfly prey. One adult wasp and all damselfly prey were collected into 70% alcohol from a total of five nests, for later identification. Observations were undertaken every 30-60 minutes during daylight hours but when no wasp activity was observed at the end of the second day, the nests were gently exposed using a small spoon to elucidate their structure.



Fig. 1. Localities where *Bembix* spp. have been recorded preying on Odonata: *B. variabilis* on damselflies (●); *B. coonumdura* on damselflies (◆); *B. minya* on damselflies (✱); *B. allunga* on libellulid dragonflies (■).

Results and Observations

Several species of sphecid wasps, including *B. minya*, had constructed nests in the pile of builder's sand described above. All nests were on the north-western side of the sand pile and the entrances about 50 cm from ground level. The two partially disturbed nests had slightly curved entrance tunnels, estimated at 20 and 25 cm in length and angled downwards at about 30° to the horizontal. At the end of each tunnel a single elongate brood chamber was found that was horizontal and about 10-12 cm in length (Fig. 2). One chamber contained 15 damselflies, comprising two obvious species based on colour differences, and a single small *Bembix* larva. The other chamber contained 19 damselflies, again comprising at least two species. These prey were retained with the damselflies from the other three nests and totalled 79 individuals, which later identification revealed to comprise four species, two coenagrionids and two lestids (Table 1).

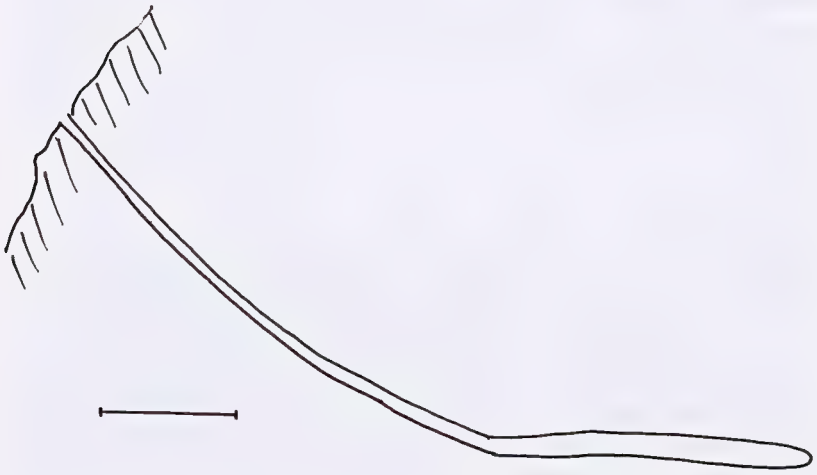


Fig. 2. Lateral aspect of the nest of *Bembix minya* showing elongate brood chamber (scale line = 5 cm; tunnel diameter not to scale).

One adult *B. minya* was collected from one of the two partially disturbed nests and no other individuals were recorded at the sand pile over the next day and a half. It is therefore possible that all five nests were constructed by the one adult female and some of them had been fully provisioned and sealed off. Given that 79 damselflies were recovered from the five nests, it seems reasonable to assume that this species provisions its brood chamber with an average of 16 prey items, a figure commensurate with the 15 and 19 prey recorded from the two partially disturbed nests.

Extensive searching of the area showed that the closest source of damselflies was from two farm dams, one approximately 200 metres to the west of the nest site and the other about 380 metres to the south-east. Several other dams were located 400-600 metres in various directions. A small number of damselflies were seen flying over the water surface of the closest dam. Several individuals were netted and these were later identified as *Austrolestes analis* (Rambur) and *A. annulosus* (Selys), the two commonest species collected by *B. minya* (Table 1).

Table 1. Damselfly species recorded from five nests of *Bembix minya* at Wistow, South Australia.

Damselfly prey	Number of individuals
Coenagrionidae	
Ischnura aurora (Brauer)	1
Xanthagrion erythroneurum (Selys)	17
Lestidae	
Austrolestes analis (Rambur)	30
Austrolestes annulosus (Selys)	31
TOTAL	79

Discussion

The observations made during this study show that predation by *Bembix* spp. on Odonata, particularly damselflies, is geographically widespread in Australia (Wheeler and Dow 1933, Evans and Matthews 1973, Evans *et al.* 1982) (Fig. 1). They also lend support to the proposal that some *Bembix* spp. may be obligate specialists on Odonata (damselflies), rather than the latter being alternative prey for polyphagous species that mostly feed on Diptera. Although there are insufficient data on prey for the genus to make definitive statements about prey group specificity, the detailed studies of Evans and Matthews (1973) and Evans *et al.* (1982) on the Australian fauna provide information on 27 of 82 described species. All except three of these 27 species specialise on a single prey group, viz. Diptera, thynnine wasps, Apidae *s.l.* (Colletinae, Halictinae, *Trigona*) myrmeleontid lacewings and Odonata. The exceptions are: *B. variabilis*, which preys mostly on Diptera but at two localities has been observed to also prey on damselflies, either exclusively (Kununurra) or in combination with Diptera so that brood chambers are provisioned with both prey groups (Darwin); *B. allunga*, which also mostly preys on Diptera as well as ascalaphid, chrysopid and myrmeleontid Neuroptera and libellulid dragonflies; and *B. moma* Evans & Matthews, the nests of which usually contain a mixture of prey groups

comprising to date three subfamilies of Apidae *s.l.*, five families of wasps (Ichneumonidae, Gasteruptiidae, Tiphiidae, Pompilidae, Sphecidae) and at least five families of flies (Evans and Matthews 1973).

The elongate brood chamber described here for *B. minya* (Fig. 2) is somewhat atypical for Australian *Bembix* in that most species construct a short chamber (Evans and Matthews 1973). However, at least one other species, *B. variabilis*, also constructs a similar elongate chamber which is undoubtedly necessary to accommodate the elongate bodies of multiple damselfly prey.

Clearly, *Bembix* spp. provide an ideal group to examine the evolutionary pathways that have led to prey switching. There is already some evidence that prey specificity is an evolutionary (fixed) trait in that the three species which exclusively prey on bees are contained within a single (presumably monophyletic) species-group. Further, the two species apparently restricted to damselflies, *B. minya* and *B. coonundura*, are closely related (R.W. Matthews, pers. comm.) and may be sister taxa. A prerequisite for such evolutionary studies would be the generation of a robust phylogeny for the Australian species, a not insurmountable task but one that would probably require molecular techniques given the likely level of morphological homoplasy within the genus.

The observations reported here are consistent with those documented for *B. coonundura* in regard to the number of damselflies provisioned per nest, and for this species and *B. variabilis* for nest structure. The three intact nests of *B. coonundura* excavated by Evans and Matthews (1973) at Lake Violet each contained about 10 damselflies, comprising two of the four species recorded here for *B. minya*, viz. *Xanthagrion erythroneurum* (Selys) and *A. annulosus*. This number and that recorded for *B. minya* are substantially lower than for the larger numbers of smaller flies recorded from nests of some *Bembix* spp., which often number in excess of 50. *Bembix coonundura* and *B. minya* presumably expend less energy in foraging for a smaller number of prey and this may explain why a single wasp was collected from the Wistow site; i.e. with fewer prey required it is possible for one wasp to provision multiple nests sequentially in a relatively short period of time, given that prey abundance is not limiting.

Finally, although the information presented here was the result of a fortuitous encounter, this study has revealed the potential for using artificial sand piles for observing and recording the nesting behaviour of *Bembix* spp. and other sphecids. At sites where soil types are mostly inappropriate for nest construction by sand wasps, artificial sites could be provided using sand of different coarseness to examine the effect of particle size on nesting success. Artificial sites provided at various times would also allow for the collection of data on seasonality in nesting and its effect on species composition of prey, plus rates of colonisation by different species.

Acknowledgments

I wish to thank the late Tony Watson for identification of the damselflies, Ian Naumann for identifying the *Bembix* species, and Bob Matthews and Sally Collins for their comments on the manuscript.

References

BOHART, R.M. and MENKE, A.S. 1976. *Sphecid wasps of the world: a generic revision.* University of California Press, Berkley; 694 pp.

EVANS, H.E. 1957. *Studies on the comparative ethology of digger wasps of the genus Bembix.* Comstock Publishing Associates, Ithaca, New York; 248 pp.

EVANS, H.E. 1966. *The comparative ethology and evolution of the sand wasps.* Harvard University Press, Cambridge; 526 pp.

EVANS, H.E. 1978. A solitary wasp that preys upon lacewings (Hymenoptera: Sphecidae; Neuroptera: Chrysopidae). *Psyche* **85**: 81-83.

EVANS, H.E., EVANS, M.A. and HOOK, A. 1982. Observations on nests and prey of Australian *Bembix* sand wasps (Hymenoptera: Sphecidae). *Australian Journal of Zoology* **30**: 71-80.

EVANS, H.E. and MATTHEWS, R.W. 1973. Systematics and nesting behaviour of Australian *Bembix* sand wasps (Hymenoptera: Sphecidae). *Memoirs of the American Entomological Institute* **20**: 1-387.

WHEELER, W.M. and DOW, R. 1933. Unusual prey of *Bembix*. *Psyche* **40**: 57-59.

A NOTE ON UNSUCCESSFUL OVERWINTERING OF LARVAE OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) IN THE BLUE MOUNTAINS, NEW SOUTH WALES

David G. James

Irrigated Agriculture Research and Extension Center, Washington State University, 24106 North Bunn Road, Prosser, Washington 99350, USA

Abstract

Fortnightly observations were made on a larval population of *Danaus plexippus* (L.) at Hazelbrook, New South Wales to provide information on winter survival in the Blue Mountains. The population was decimated in July and August apparently by strong, cold winds. Only small numbers of larvae and pupae survived until September and none produced adult butterflies.

Introduction

The monarch or wanderer butterfly, *Danaus plexippus* (L.), has an extensive summer range in eastern Australia, breeding wherever suitable host plants occur (Smithers 1977). During autumn the southern part of this range (in NSW) contracts, forming overwintering populations in the Sydney and northern coastal areas of New South Wales. The Sydney basin harbours both breeding and non-breeding overwintering populations (Smithers 1965, James 1979, 1981). The westward limit of reproductive populations in the Sydney area has not been established, although larvae have not been recorded west of the Great Dividing Range during winter (Smithers 1977).

The two prime requirements for the survival and development of *D. plexippus* larvae are an adequate food supply and body temperatures greater than the developmental zero of 11-12°C for much of the time (Rawlins and Lederhouse 1981, Zalucki 1982). Milkweed, *Gomphocarpus* (= *Asclepias*) *fruticosus* (L) (Asclepiadaceae), the major host plant of *D. plexippus* in New South Wales, occurs at elevations of up to at least 700 m during winter in the Blue Mountains, west of the Sydney basin (James, unpub. obs.). The presence of host plants, together with the ability of *D. plexippus* larvae to increase body temperatures substantially when exposed to sunshine (James 1986), indicate that survival of larvae during winter in the Blue Mountains may be possible.

This study provides information on overwintering by larvae of *D. plexippus* during 1984 at one site in the Blue Mountains.

Materials and Methods

The author's garden at Hazelbrook, 17 km east of Katoomba at an altitude of 650 m, was chosen as the study site. A small patch of 25-30 milkweed plants, occupying an area of approximately 1 m^2, was established on a south-facing slope in December 1983. Plants ranged in size from, 0.5-1.5 m tall. The surrounding area was cultivated with vegetables. Natural bushland occurred 5 m down-slope of the milkweed.

On 26 May 1984, 100 second instar larvae of *D. plexippus* were introduced to the milkweed patch. One month later (24 June) a second batch of 100 third instar larvae was released. The milkweed was examined at fortnightly intervals until the end of September and data recorded on number and instar of larvae. Plants were searched thoroughly on each occasion and it is likely that only a small number of larvae escaped detection. Pupae found on the plants and general information on larval development and mortality were recorded. Weather conditions were recorded also; the ambient temperature was continuously monitored by a thermohygrograph situated 1 m above ground level.

Results

The population of 200 larvae introduced to the milkweed in early winter failed to produce a single butterfly. Numbers of larvae, fairly stable in June, declined dramatically during July and August (Table 1). Small numbers of pupae were produced but many were malformed and all died. The substantial depletion of larvae during July and August coincided with the occurrence of frequent cold and strong south to south-westerly winds which were often accompanied by rain, sleet or snow. Such weather systems often persisted for many days. The first of these severe cold fronts occurred in the first week of July. On 4 July snow covered the ground for more than 5 hours. Subsequent examination of the milkweed revealed many larvae had been blown to the ground by the gale force winds and had died. Similar conditions occurred at the end of July and on four occasions during August.

Table 1. Number of larvae, pupae and relative percentages of instars of *D. plexippus* during May-September 1984 at Hazelbrook, NSW.

Date	No. of larvae	Relative % of instars				No. of pupae
		2nd	3rd	4th	5th	
26.v. *	100	100	0	0	0	0
9.vi.	90	30	70	0	0	0
23.vi.	82	0	67	33	0	0
24.vi. *	182	0	92	8	0	0
7.vii.	130	0	81	19	0	0
21.vii.	64	0	20	51	29	1
4.viii.	32	0	0	31	69	6
18.viii.	12	0	0	17	83	15
1.ix.	7	0	0	0	100	22
15.ix.	1	0	0	0	100	23
29.ix.	0	0	0	0	0	25

* Denotes introduction of 100 second or third instar larvae.

Observations indicated that larvae were most vulnerable when ecdysis coincided with cold, windy conditions, and invariably died.

Temperatures during the period of study ranged from 1-19°C and daily maxima and minima averaged 12.6 and 6.2°C respectively (Table 2). July was the coldest and most overcast month, while June and August were characterised by similar temperatures and mainly sunny skies. Strong winds were common during July and August but June was mainly calm (Table 2).

Table 2. Climate data for Hazelbrook NSW, June-August 1984. Days were recorded as "sunny" if there were more than 4 hours of sunshine; days were recorded as windy if winds exceeded 20 km/h for more than 1 hour.

	Temperature °C				No. of sunny days	No. of windy days
	Maximum		Minimum			
	Range	Daily mean (±SE)	Range	Daily mean (±SE)		
June	9.5-17.5	13.5 (2.2)	4.5-11.0	6.9 (1.4)	22	2
July	6.0-13.5	10.5 (1.8)	1.0-8.0	4.9 (1.6	17	16
August	10.0-19.0	13.9 (2.5)	3.0-10.0	6.8 (1.8)	25	22
June-August	6.0-19.0	12.6 (2.7)	1.0-11.0	6.2 (1.8)	64	40

Discussion

Overwintering in the Blue Mountains poses considerable problems for the survival of larvae of the monarch butterfly. Whilst cold-cool (0-12°C) conditions (e.g. June) alone do not appear to drastically threaten survival and development of larvae, their occurrence in combination with prolonged exposure to strong winds (e.g. August) produces substantial mortalities. This mortality may have been caused by a wind chill effect, and/or an inability by larvae to recolonise host plants after being blown to the ground. Despite cool conditions, calm and sunny weather in June produced good larval development and excellent survival. An estimated one third of the population progressed from second to fourth instar. This was most likely facilitated by the predominance of sunny days which enabled larvae to elevate body temperatures substantially, thus accelerating development. Winter monarch larvae exposed to sunshine under calm conditions can achieve body temperatures 10-22°C higher than ambient (James 1986). However, even light winds drastically reduce solar heat gains (May 1979). The sustained windy conditions during August produced devastating mortalities and development of survivors was minimal. Even larvae that pupated successfully in late August-September eventually died, indicating that irreversible physiological damage was suffered by the larvae.

The southerly aspect of the garden, despite a certain amount of protection provided by the nearby mature bushland, undoubtedly contributed towards its unsuitability as an overwintering site for *D. plexippus* larvae. It seems likely that reduction of the chill factor by adequate buffering from strong winds would allow good overwintering survival of monarch larvae in the Blue Mountains, provided abundant sunshine was available. Due to air circulation from lower elevations and tree cover, many lower-mid elevation localities in the Blue Mountains are relatively frost-free, allowing survival of the frost-sensitive *G. fruticosus*. In the Sydney basin, the most successful winter breeding populations of *D. plexippus* invariably occur on north facing slopes (James, unpub. obs.) and such situations would offer the best opportunity for survival of overwintering larvae in the Blue Mountains.

References

JAMES, D.G. 1979. Observations on two overwintering clusters of *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) in the Sydney area during 1978. *Australian Entomological Magazine* **5**: 81-85.

JAMES, D.G. 1981. Studies on a winter breeding population of *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) at Spencer, New South Wales. *General and Applied Entomology* **13:** 47-53.

JAMES, D.G. 1986. Thermoregulation in *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae): Two cool climate adaptations. *General and Applied Entomology* **18:** 43-47.

MAY, M.L. 1979. Insect thermoregulation. *Annual Review of Entomology* **24:** 313-349.

RAWLINS, J.E. and LEDERHOUSE, R.C. 1981. Developmental influences of thermal behaviour on Monarch caterpillars (*Danaus plexippus*): an adaptation for migration (Lepidoptera: Nymphalidae: Danainae). *Journal of the Kansas Entomological Society* **54:** 387-408.

SMITHERS, C.N. 1965. A note on overwintering in *Danaus plexippus* (Linnaeus) (Lepidoptera: Nymphalidae) in Australia. *Australian Zoologist* **13:** 135-136.

SMITHERS, C.N. 1977. Seasonal distribution and breeding status of *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) in Australia. *Journal of the Australian Entomological Society* **16:** 175-184.

ZALUCKI, M.P. 1982. Temperature and rate of development in *Danaus plexippus* and *D. chrysippus* (Nymphalidae). *Journal of the Australian Entomological Society* **21:** 241-246.

PARASITISM OF *ACACICOLA ORPHANA* (ERICHSON) (COLEOPTERA: CHRYSOMELIDAE) IN TASMANIA

Tara L. Simmul[1] and Anthony R. Clarke[2]

[1] *Cooperative Research Centre for Sustainable Production Forestry and University of Tasmania, GPO Box 252-12, Hobart, Tas 7001*

[2] *Australian School of Environmental Studies, Nathan Campus, Griffith University, Brisbane, Qld 4111*

Abstract

Parasitism of late-instar *Acacicola orphana* larvae was assessed at six locations throughout Tasmania in October 1997. Overall rates of parasitism were very low and only one parasitoid was collected, a species of *Lixophaga* Townsend (Diptera: Tachinidae). Only 17 tachinid pupae were reared from 600 larvae (2.83% parasitism), but the number of larvae initially observed bearing tachinid eggs was higher (32 larvae, 5.3% parasitism). The emergence rate of adult tachinids was low, with only four of the 17 pupae (23%) yielding flies. The number of larvae bearing tachinid eggs between sites ranged from 0-17 and was positively and significantly correlated with tree damage estimates made at the collection sites during the previous season.

Introduction

The fireblight beetle, *Acacicola* (= *Pyrgoides*) *orphana* (Erichson), defoliates the temperate bipinnate acacias *Acacia dealbata* Link. and *A. mearnsii* de Wild (French 1911, Froggatt 1923, McKeown 1942). Defoliation is more apparent in spring when the winter-developing larvae are in the fourth (final) instar. Severely affected trees can lose all foliage and larvae chew green bark from the stems, effectively ring-barking the trees. Repeated severe defoliation may result in tree death. Although *A. dealbata* and *A. mearnsii* have been identified as having potential for pulp and paper making (Clark *et al.* 1994), there is a reluctance to grow these species because of the severe defoliation caused by *A. orphana* (D. de Little, pers. comm.).

An understanding of the natural enemies of *A. orphana* is needed if IPM systems are to be developed for this insect. Elliott (1978) observed only very low numbers (6 specimens from 'a number of collections ... containing several hundred individuals per collection') of two tachinid parasitoids, *Deltomyza australiensis* (Malloch) and a species of *Lixophaga* Townsend in *A. orphana* populations in the Florentine Valley, south-central Tasmania. Elliott (1978) noted that *A. orphana* larvae develop throughout the colder months of the year and he hypothesised that conditions in his study area were unfavourable for many predators and parasitoids. In 1997 we conducted a more extensive Tasmanian survey of *A. orphana* larval populations, with the aim of identifying additional parasitoid species and spatial variance in parasitism rates.

Materials and methods

No parasitism of eggs, first or second instar larvae of *A. orphana* has been observed (Elliott 1978, T. Simmul, pers. obs.). Therefore, for this study only

third and fourth instar larvae were collected from six Tasmanian sites on one occasion each in mid-October, 1997. Site locations were: Lake Leake (147°38'S, 41°58'E), Buckland 1 (147°44'S 42°39'E), Buckland 2 (147°36'S 42°38'E), Conara (147°27'S 41°50'E), Dromedary (147°06'S 42°46'E) and Perth (147°09'S 41°35'E). At all sites *A. dealbata* was the predominant *Acacia* species. During October 1996 (the previous season), all sites except Dromedary were assessed for *A. orphana* defoliation using a visual scoring system based on 10 trees per site. To obtain the site score, 10 trees were scored visually with values ranging from zero, representing no damage, to five, for complete foliage removal and some bark chewed. The values were then averaged across the 10 trees and rounded to the nearest whole number.

When cultures were first established, each larva was examined individually and records made of any tachinid eggs present on the body. One hundred larvae from each site were maintained in ventilated containers under constant conditions (17°C ± 5°C; 8L, 16D, ~66% R.H.). Cultures were cleaned and fresh foliage was provided three times weakly. At these times any dead larvae were counted and the apparent cause of death noted. Final counts were made of the number of adult beetles, number of parasitoid pupae and the number of adult parasitoids emerging.

The relationship between the number of larvae carrying tachinid eggs and the defoliation score during the previous season was examined using linear regression (Excel 6.0).

Results

Only 5.3% of collected *A. orphana* larvae bore tachinid eggs, with one to three eggs found per individual. A few tachinids (0.5%) developed in larvae with no eggs on the cuticle, implying that the eggs had been dislodged after the tachinid larva eclosed or that the parent fly had oviposited on an earlier instar host. The tachinid was a larval endoparasitoid, killing the host late in the final larval or prepupal stage, when the puparium protruded from a split in the host's cuticle. Adult flies, identified as *Lixophaga* sp., emerged after approximately 10 days. Only one tachinid developed in each host larva. Parasitised *A. orphana* larvae did not appear to behave differently from non-parasitised larvae.

The highest amount of parasitism was at Conara (17% of larvae carrying eggs), while the lowest was 1% at Perth and Buckland 2. At Perth, no egg was observed on the larva; however a single tachinid puparium was observed. No flies were reared from either of these locations (Table 1). Unidentified mortality in the cultures caused losses of 18-27% (average 24%), some of which may have been caused by parasitoids which subsequently failed to emerge. From all collections only 17 tachinid pupae were recorded, from which only four adult flies emerged. No hyperparasitoids were observed.

A positive relationship (r = 0.96) existed between the site defoliation scores made in the season prior to the collections and the number of eggs found on the larvae in 1997.

Table 1. Tree defoliation scores and *Acacicola orphana* larval parasitism records for six sites in Tasmania. Initial sample size from each site = 100 larvae. Defoliation score range: 0 = none; 5 = total defoliation.

Site	Site defoliation score	No. of larvae carrying tachinid eggs	No. of larvae with a tachinid pupa	No. of adult flies emerging from pupae
Lake Leake	2	2	3	2
Conara	5	17	6	2
Buckland 1	3	8	2	0
Buckland 2	1	1	0	0
Perth	0	0	1	0
Dromedary	-	4	5	0

Discussion

In a collection of 600 larvae from six sites, larval parasitism (based on the presence of tachinid eggs) of *A. orphana* in Tasmania, averaged across all sites, was only 5%. Direct mortality attributable to parasitism was around 3%. This parasitism rate seems similar to that obtained by Elliott (1978), although a direct comparison is difficult because of the way his results are presented. Unlike Elliott, only one parasitoid species, *Lixophaga* sp., was obtained. Although other authors have recorded very low parasitism rates of paropsine chrysomelids (the group to which *A. orphana* belongs), tachinid parasitism rates of species such as *Chrysophtharta bimaculata* (Olivier) and *Paropsis atomaria* Olivier are normally 2-7 fold higher than that recorded for *A. orphana* (Tanton and Khan 1978, de Little 1982, Tanton and Epila 1984, de Little *et al.* 1990). The reason for the low parasitism obtained may be due to the winter cycle of *A. orphana* larvae, as suggested by Elliott (1978), but this is difficult to test directly. Alternatively, a greater temporal sampling of larvae may show seasonal cycles in parasitism rates, of which we have only recorded the low period. Seasonality of tachinid parasitism rates has been demonstrated for *P. atomaria* (Tanton and Khan 1978, Tanton and Epila 1984).

If the level of tree defoliation is related to *A. orphana* population levels, this may imply delayed density dependence between beetle numbers and parasite numbers. Obviously the sample size is very low and this needs to be repeated.

The low parasitism rate, coupled with the low number of adult flies successfully developing and emerging from *A. orphana* larvae, suggests that

this species may be a relatively poor host for *Lixophaga* sp. More studies on field parasitism are required to quantify the effect of this parasitoid on populations of *A. orphana*.

Acknowledgments

The authors would like to thank Mr S. Paterson for technical assistance and Dr B. Cantrell for identification of the tachinid. Dr D. de Little provided unpublished information. This work was supported by an Australian Postgraduate Award (Industry) scholarship partnered by the Tasmania Forest Research Council, the Australian Research Council and the Cooperative Research Centre for Sustainable Production Forestry.

References

CLARK, N.B., BALODIS, V., GUIGAN, F. and WANG, J.X. 1994. Pulpwood potential of Acacias. Pp 196-202, *in* BROWN, A.G. (ed.), *Australian tree species research in China.* ACIAR, Canberra; 226 pp.

de LITTLE, D.W. 1982. Field parasitization of larval populations of the *Eucalyptus*-defoliating leaf-beetle, *Chrysophtharta bimaculata* (Olivier) (Coleoptera: Chrysomelidae). *General and Applied Entomology* **14**: 3-6.

de LITTLE, D.W., ELLIOTT, H.J., MADDEN, J.L. and BASHFORD, R. 1990. Stage-specific mortality in two field populations of immature *Chrysophtharta bimaculata* (Olivier) (Coleoptera: Chrysomelidae). *Journal of the Australian Entomological Society* **29**: 51-55.

ELLIOTT, H.J. 1978. Studies on the fireblight beetle, *Pyrgoides orphana* (Erichson) (Coleoptera: Chrysomelidae) and its effect on the growth of silver wattle in Tasmania. *Australian Forestry* **41**: 160-166.

FRENCH, C. 1911. *Handbook of the destructive insects of Victoria. Part V.* Government Printer, Melbourne; 169 pp.

FROGGATT, W.W. 1923. *Forest insects of Australia.* Government Printer, Sydney; 171 pp.

McKEOWN, K.C. 1942. *Australian insects.* Royal Zoological Society of New South Wales, Sydney; 304 pp.

TANTON, M.T. and EPILA, J.S.O. 1984. Parasitization of larvae of *Paropsis atomaria* Ol. (Coleoptera: Chrysomelidae) in the Australian Capital Territory. *Australian Journal of Zoology* **32**: 251-259.

TANTON, M.T. and KHAN, S.M. 1978. Aspects of the biology of the eucalyptus-defoliating chrysomelid beetle *Paropsis atomaria* Ol. in the Australian Capital Territory. *Australian Journal of Zoology* **26**: 113-120.

A NEW GENUS AND SPECIES OF HAWK MOTH (LEPIDOPTERA: SPHINGIDAE) FROM PAPUA NEW GUINEA

R.B. LACHLAN

Entomology Department, Australian Museum, 6 College Street, Sydney, NSW 2000

Abstract

Altijuba oktediensis gen. et sp. nov. is described from a single female from Tabubil, Western Province, Papua New Guinea.

Introduction

An undescribed genus and species of hawk moth was collected at Tabubil in the mountains of Western Province, Papua New Guinea, in May 1993. This new taxon is distinct from all genera previously recorded from Papua New Guinea and West Irian.

Altijuba gen. nov.

(Figs 1-3)

Type species. *Altijuba oktediensis* sp. nov.

Description. Antenna short, filiform except for terminal segments which gradually taper; weakly hooked. Eyes small in relation to overall size. Palps not large but erect, closely appressed to head. Head and thorax with distinct medial scale crest. Abdomen very short and stout, tapering abruptly.

Middle tibia with one pair and hind tibia with two pairs of small spurs. Hind legs short. Coxae densely covered with long hair scales. Fore femur covered by shorter, flattened scales. Hind femur with distinctive thin crest of long scales on ventral surface. Distal half of tibia with triangular shaped crest of long scales on dorsal surface. All legs narrow and of thread-like appearance.

Forewing costa straight with apex of wing falcate; termen almost straight from R_5 to M_3, serrate and angled inwards from M_3 to tornus; distal edge of inner margin at tornus bluntly tooth-like; two prominent cream stigmata visible on upperside at end of discal cell, one above the other; only one prominent stigmata visible on underside. Hindwing with apex rounded to Rs vein; termen slanting inwards but almost straight from Rs to M_3, then serrate to 1A+2A; tornus with tooth-like projection.

Etymology. The generic name *Altijuba* is derived from the Latin words 'altus' meaning high and 'juba' meaning mane or crest.

Altijuba oktediensis sp. nov.

(Figs 1-3)

Type. *Holotype* ♀, PAPUA NEW GUINEA: Tabubil, Western Province, 5°15'S 141°13'E, 650 m, 11.v.1993, R.B. Lachlan. Holotype in Australian National Insect Collection, CSIRO, Canberra.



Figs 1-2. *Altijuba oktediensis* gen. et sp. nov., holotype female. (1) upperside, legs reset for examination; (2) underside.

Description. Female (Figs 1-3). Forewing length 41 mm. Antenna light brown and filiform. Palpi grey-brown above, contrasting orange-brown below. Small cream spot below and slightly forward of each eye. Head, thorax and abdomen uniform grey-brown on upper surface. Head and thorax with dark brown, longitudinal, medial crest. Underside of thorax with dense, orange-brown pilosity. Single, dark brown, transverse line on posterior edge of upperside of third abdominal segment. Proximal end of all tibiae with cream spot on dorsal surface. Underside of abdomen orange-brown with distinct sheen and three thin, disconnected, brown longitudinal medial lines; each segment with mauve and brown posterior edge.



Fig. 3. *Altijuba oktediensis* gen. et sp. nov., holotype female at rest.

Forewing upperside pattern as in Fig. 1; ground colour dark brown with lighter markings. Dark brown apical band. Thin, dark brown, postmedian line pointed outwards along veins R_5 to M_3 and 1A+2A. Two dark brown lines beginning at submedian and postmedian areas of costa, curving inwards and joining at inner margin one third of length from base and enclosing a dark, triangular patch. Two prominent cream stigmata, one above the other, at end of discal cell. Three simple brown fasciae between subbasal and submedian areas. Underside with single, strongly visible stigma. Basal and subcostal areas grey-brown. Postmedian area lighter brown. Single thin brown median band from R_4 curving inwardly to CuA_2. Single serrate, thin brown postmedian line from R_5 to CuA_2. Subapical area dark brown with diffuse black and orange scaling. Light mauve subterminal band, straight to M_3, inner edge of band serrate proximally above veins CuA_1, CuA_2 and 1A+2A.

Hindwing upperside with dark brown ground colour. Thin, orange-brown apical and terminal band to M_3. Dark, pink-brown band with thin black anterior and posterior lines from just above vein CuA_1 to inner margin above tornus distally. Underside with ground colour orange-brown, pink basally. Dark grey along costa, lighter grey in anal area tending light brown towards tornus. Small faint stigma at end of cell. One straight, thin, dark brown transverse median line from vein $Sc+R_1$ to CuA_2. Two thin, faint, serrate, parallel postmedian lines terminating above tornus. Broad mauve terminal band from apex to vein CuA_2, serrate proximally between veins M_3 and CuA_2.

Male. Unknown.

Distribution. Western Province, Papua New Guinea.

Etymology. The specific name *oktediensis* is derived from the Ok Tedi river, which flows past the mining town of Tabubil, the only known locality for the species.

Discussion

As the only known specimen is a female, the genitalia have not been examined. External characters have been used to characterize the genus and to determine where it probably belongs. When males become available the genitalia will provide further clues as to its placement. Neither Mackey (1975) nor D'Abrera [1987] illustrated any species that closely resemble this specimen. It was first noted as an unidentified species by Moulds and Lachlan (1998). The forewing shape resembles *Eurypteryx* Felder and *Gehlenia* Bryk but is more serrate. The hindwing shape also has some resemblance to *E. falcata* Gehlen but is also more serrate. The two stigmata on the forewing upperside of *A. oktediensis* are a prominent feature and are also found, to a lesser degree, on *E. shelfordi* Rothschild & Jordan. However, no species of *Eurypteryx* has the orange-brown underside to the hindwings and abdomen seen on the new species. Also, *Altijuba* has very small eyes and short palps which do not project as they do in *Eurypteryx* and *Acosmeryx* Boisduval.

Dr Ian Kitching (personal communication) has examined photographs of the holotype and is of the opinion that the new genus is probably closely related to *Eurypteryx* and may well be somewhat sexually dimorphic, with the male being more uniform in colour and with smaller stigmata. A distinctive feature of this new species is the unusually short, stout abdomen, similar to the African sphingid *Dovania poecila* Rothschild & Jordan. The vast majority of world Sphingidae have a much longer abdomen in both sexes. The crest on the head and thorax of *Altijuba* is similar to that in *Gehlenia*. The orange-brown underside of the hindwing is also common to some *Acosmeryx* species but *Altijuba* differs from these in the shape of both wings. The leg scaling is another distinctive feature of *Altijuba*.

This new species has a number of characters found in several different genera as well as its own distinctive features. It cannot be placed in a currently described genus and is therefore placed in a new genus on its own.

Despite over three years of comprehensive collecting between 1991-93 and in March-April 1994, at several sites in and around the Tabubil region, only a single specimen of this species was collected. During this time thousands of specimens, covering 66 species and 20 genera, were either sighted, examined or collected (Moulds and Lachlan 1998). Dr Kitching has suggested that if *Altijuba* is related to *Eurypteryx* this may explain its rarity as it is well known that *Eurypteryx* species do not readily come to light.

Acknowledgments

For advice and helpful comments on the manuscript I sincerely thank Mr Ted Edwards (Australian National Insect Collection, CSIRO, Canberra) and Dr Ian Kitching (The Natural History Museum, London). I am most grateful to Ok Tedi Mining Ltd for their field support, especially to former managers of the environment section, Murray Eagle and Ian Wood, and to Robert Murphy, Chief Geologist. Without their support and permission to access collecting sites this work would not have been possible. I would also like to thank my wife, Deborah Lachlan, for typing the manuscript.

References

D'ABRERA, B. [1987]. *Sphingidae Mundi, hawk moths of the world. Based on a checklist by Alan Hayes and the collection he curated in the British Museum (Natural History).* E.W. Classey, Faringdon; ix+226 pp.

MACKEY, A.P. 1975. Hawk moths of Port Moresby. *Occasional Papers of the Biology Department, University of Papua New Guinea* **4**: 1-20.

MOULDS, M.S. and LACHLAN, R.B. 1998. An annotated list of the hawk moths (Lepidoptera: Sphingidae) of Western Province, Papua New Guinea. *Australian Entomologist* **25**(2): 45-60.

BACK ISSUES OF AUSTRALIAN ENTOMOLOGIST.

AUS$3 per volume or AUS$1 per issue, incl. postage. Stocks of some issues are in short supply. Parts in parenthisis comprise one issue. * includes beetle fascicle. Orders to Grég Daniels, Dept of Zoology & Entomology, University of Queensland, Brisbane, Qld, 4072. 07 3365 7084. g.daniels@ento.uq.edu.au

Vol.	Part					
2	1	2		4	5	6
3	1	2	3		5	6
4	1	2	3	4	5	
5		2	3	4	5	6
6		2	3	4	5	6*
7		2	3	4	5	6
8		(2-3)				6
9	1	(2-3)		4	5	6
10	1	(2-3)		4	5	6
11	1	2	3	(4-5)		6
12	1	2	(3-4)		5	6
13	(1-2)		(3-4)		(5-6)	
14	(1-2)		3			6
15	1	2	3	4		
16	1	2*	3	4		
17	1	2	3*	4		
18	1	2	3	4		
19	1	2*	3			
20	1	2	3	4		
21	1	2	3	4		
22	1	2	3	4		
23	1	2	3*	4		
24	1	2	3	4		
25	1	2	3	4		

ENTOMOLOGICAL NOTICES

Items for insertion should be sent to the editor who reserves the right to alter, reject or charge for notices.

FOR SALE: Butterflies from all parts of the world. Papua New Guinea, Peru, Indonesia, Thailand, China, Africa, Brazil, Colombia, etc. Papilionidae inc. *Parnassius*, *Delias*, *Charaxes* etc. Free catalogue. David Hall, 6 Rule St, Cambridge Park, N.S.W., 2747. Ph. 02 4731 2410.

ENTOMOLOGICAL BOOKS. Pemberley Books are specialist suppliers of entomological literature across the world. Send for our free catalogue which lists a wide range of antiquarian, second-hand and new natural history titles. Pemberley Books, Ian Johnson, 34 Melrose Close, Hayes, Middlesex, UB4 0AZ, England. Tel/Fax: +44 181 561 5494. E-mail: ij@pembooks.demon.co.uk

WANTED. Any information regarding *Rhytiphora macleayi* (Coleoptera: Cerambycidae), particularly from private collections. Mark Hura, 111 Oleander Drive, Parafield Gardens, S.A., 5107.

NOTES FOR AUTHORS

Manuscripts submitted for publication should, preferably, be type-written, double spaced and in triplicate. Refer to recent issues for layout and style.

All papers will be forwarded to two referees and the editor reserves the right to reject any paper considered unsuitable.

Papers longer than eight printed journal pages will normally not be accepted.

Papers will be accepted only if a minimum of 100 reprints is purchased. Manuscripts occupying less than one printed page may be accepted without charge if no reprints are required. Charges are as follows: cost per printed page $25 for 100 copies. Page charges may be reduced at the discretion of the Publications Committee.

Illustrations: Both colour and B & W photographs must be submitted at the size they are to appear in the journal. Line drawings should be about twice their required size.

Address papers to: The Editor
The Australian Entomologist
P.O. Box 537,
Indooroopilly, Queensland, 4068

Printed by Hans Quality Print, 20 Lyons Terrace, Windsor, Qld, 4030

THE AUSTRALIAN
Entomologist

Volume 26, Part 3, 10 December 1999

CONTENTS

AUSTIN, A.D.
Use of Odonata as prey by sand wasps, *Bembix* spp. (Hymenoptera: Sphecidae). 77

JAMES, D.G.
A note on unsuccessful overwintering of larvae of *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) in the Blue Mountains, New South Wales. 83

LACHLAN, R.B.
A new genus and species of hawk moth (Lepidoptera: Sphingidae) from Papua New Guinea. 91

MULLER, C.J.
A new species of *Leuciacria* Rothschild & Jordan (Lepidoptera: Pieridae) from montane New Ireland, Papua New Guinea. 65

ORR, A.G.
Possible postcopulatory mate guarding in *Ornithoptera euphorion* (Gray) (Lepidoptera: Papilionidae). 71

SIMMUL, T..L. and CLARKE, A.R.
Parasitism of *Acacicola orphana* (Erichson) (Coleoptera: Chrysomelidae) in Tasmania 87

ENTOMOLOGICAL NOTICES Inside back cover.

ISSN 1320 6133